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FIRST FLOWERING DATES FOR SPRING-BLOOMING PLANTS OF THE WASHINGTON, D.C., AREA FOR THE YEARS 1970 TO 1983

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Abstract.—The first-flowering dates for spring-blooming plants (both native/naturalized and cultivated species) have been recorded by volunteers in the Department of Botany, National Museum of Natural History, since 1970. The first fourteen years (1970–1983) of these observations are tabulated, and the native/naturalized records are analyzed briefly. Over 100 persons contributed observations, recording 397 native/naturalized species and 704 cultivated species. Bar graphs of first-flowering dates are presented for all native/naturalized species for which there are four or more years of records, and comparisons of cumulative numbers of woody, perennial, biennial, and annual species coming into flower by a certain date are graphed. Variation in first-flowering dates from year to year within and among species is described and possible explanations are discussed.

Phenology is the study of periodic cycles in biological events and their relation to climate. One important phenological cycle is flowering in plants. In temperate areas, such as the mid-Atlantic region, this cycle is an annual one. Flowering plants are generally dormant throughout the winter but renew growth in spring. Many species flower in the spring within a few weeks after growth resumes. Several factors, which are seasonal themselves, are well known to correlate with flowering time. Among these are (1) temperature, (2) day-length, (3) degree of canopy closure, (4) potential for pollination, i.e., availability of pollinators or suitability for wind-pollination, and (5) microclimate. Recently, Fagerström and Agren (1980) have proposed that competition for seedling establishment may also influence the phenological spread of flowering. While flowering time may vary greatly from year to year, each species has its own approximate timetable, and there is an overall flowering pattern as the season progresses.

This study was begun by Shetler in 1970 as an informal effort to record the first dates of blooming for as many spring-flowering woody and herbaceous species as possible in the immediate Washington, D.C., area. To ensure as wide a coverage as possible, he enlisted the help of other interested persons by posting a recording chart outside his office in the Department of Botany at the Smithsonian Institution, and soon others were contributing regularly. The project quickly proved popular as a means of following the progress of spring and became an annual tradition, which has been continued down to the present. Each year the chart is put up at the beginning of the calendar year, and recording is continued through May 31st. At the outset, June 1st was selected as the arbitrary cutoff for the spring season.

After the annual observations had accumulated for several years, it became apparent that they were adding up to a unique phenological record for the area, and efforts were begun to computerize the data. Despite the large number of observers and recording variability introduced thereby, the flowering dates were becoming predictable

and the species comparisons reliable as the years of data accumulated.

In 1983, after 14 springs of recording first-flowering dates in the manner described, it seemed obvious that the annual observations were beginning to yield diminishing returns and that the time had come to summarize what had been learned. Accordingly, the authors began to process and analyze the first 14 years of records, and the results of the analysis are presented in this paper.

Lester Ward, in his important early flora of Washington and vicinity published in 1881, included observations of flowering dates for 122 species of native and naturalized plants. More recently, two studies of spring flowering times have been made in this area. Terrell (1970) produced an annotated list of spring-flowering plants of the Chesapeake and Ohio (C&O) Canal with general flowering information on 342 species. Thomas (1963, 1965) made detailed studies of 286 species flowering on Theodore Roosevelt Island in the Potomac River at Washington, D.C.

The Washington, D.C., area lies on the juncture of the Piedmont and the Coastal Plain, with the Piedmont to the northwest and the Coastal Plain to the southeast. The Piedmont has a marked intrusion of Appalachian Mountain and northern plants, while the Coastal Plain area, i.e., lower Potomac River, is rich in marsh species (Hitchcock and Standley 1919).

A record of first-flowering dates provides a practical guide for such activities as teaching, planning fieldtrips, and collecting research materials during the spring season. Such a list serves as a basis for determining when the bulk of the species begins to bloom in the spring season and in detecting how the number of species coming into flower changes through the course of the season. Other aspects of spring flowering that we wished to examine were (1) the relationships of peaks of first bloom to life-form and to native and naturalized vs. cultivated species, (2) the patterns of year-to-year variation in first-flowering dates within individual species, and (3) the types of species that are the most or least variable.

Methods

The data analyzed here are dates of first-flowering or anthesis recorded for the years 1970 through 1983 for species coming into bloom between January 1st and June 1st. A species was not always observed in its initial flowering stage. If flowering was more advanced when first observed, then the approximate stage of flowering (e.g., peak-flowering, late-flowering) was recorded. Any given species was recorded only once in any given year.

"Date of first-flowering," as used in this study, requires explanation. "Flowering" is taken to mean the stage at which a perfect flower or a male flower is shedding pollen or a female flower is receptive to pollen. "First-flowering," literally, would be the moment at which the very first flower begins to shed pollen or display receptive stigmas. A "first-flowering date," therefore, would be the date for a given species within the study area on which the first flower of the season begins to shed pollen or display receptive stigmas. The study also includes some gymnosperms and other non-flowering plants. The date of "first-flowering" for these species is the date when spore- or pollen-shedding began.

Because, for a region as large as the D.C. area, it is impossible in virtually all cases to establish this date on an absolute basis, in actual practice "date of first-flowering" becomes the date on which a species is first *observed* to be in flower. The validity of the concept of first-flowering depends, therefore, on observing the species as early as possible in their annual flowering cycles, i.e., as close as possible to the absolute dates of first-flowering. In this study most of the species (more than 90 percent) recorded each year were actually observed in very early, though not necessarily the absolute earliest,

stages of flowering. Each year, however, some of the species recorded were in more advanced stages of flowering when first observed. For the purposes of this paper, we eliminated all records based on flowering stages beyond what was deemed to be the peak-flowering stage. Ranges of first-flowering dates (earliest and latest ever recorded) and averages of first-flowering dates were computed on the basis of all the remaining dates, including some that were recorded for species that had already reached peak-flowering by the time that they were observed.

All observations were made by volunteers, and the species recorded each year are the ones that the volunteers happened to observe in first- or early-flowering stage in the given year. Because it was an entirely informal, voluntary project, there was no systematic effort to include all spring-flowering species or even the same set of species every year. Thus, while many species were recorded year after year, they were not necessarily recorded from the same localities or by the same observers every year, and many species happened to be recorded only once during the entire 14-year period. Many other spring-flowering species never happened to be reported even once during this 14-year period. This was particularly true of grasses and sedges. Altogether, 109 persons contributed one or more observations to the flowering records over the 14 years.

All observations were recorded from localities within about a 35-mile radius of the center of the District of Columbia. The localities are plotted on Fig. 1 for all first-flowering records of native and naturalized species only.

From the outset, first-flowering dates were recorded for exotic species (e.g., hyacinth, *Hyacinthus orientalis*) growing under cultivation as well as for native and naturalized species. The status of the species, whether "cultivated" or "native or naturalized," was coded into the computer record, and the two groups of records were analyzed separately. The complete list of the native and naturalized species that were recorded over the 14-year period (397 spp.) is presented in Appendix 1, and the list of cultivated species that were recorded more than once (401 spp.) is presented in Appendix 2. In these appendices, the range of first-flowering dates, the average first-flowering date, and the number of observations used in these determinations are presented.

For certain native and naturalized species, some of the flowering dates were recorded from plants being cultivated as ornamentals (e.g., as shade trees or as wildflowers). A native or naturalized species was treated as a "cultivated" species and analyzed with the cultivated group only when *all* recorded dates were for plants growing in cultivation. This explains why a few locally native or naturalized species appear in Appendix 2. In the case of native or naturalized plants, therefore, no distinction was made between flowering observations from the wild and from cultivation when both kinds of observations had been made for the same species; all observations were treated as though made in the wild. Native and naturalized species of eastern North America that are unknown in the wild from the local area of this study automatically were treated as "cultivated" species and appear in Appendix 2.

Except for the inclusion of Appendix 2, we have confined our analysis in this paper to the native and naturalized species. Because all of the records are sight records without preserved specimen vouchers, the cultivated taxa, in particular, present major taxonomic and nomenclatural problems. Many were not identified to species in the first place, while in other cases the identifications are debatable. With cultivated plants there also is the problem of cultivars. The nomenclature for the cultivated plants in Appendix 2 follows *Hortus Third* (Bailey and Bailey 1976), as far as possible. Otherwise, the names were retained as recorded by the observers, and the validity of the identifications rests on the authority of the observers. Varietal names are retained only

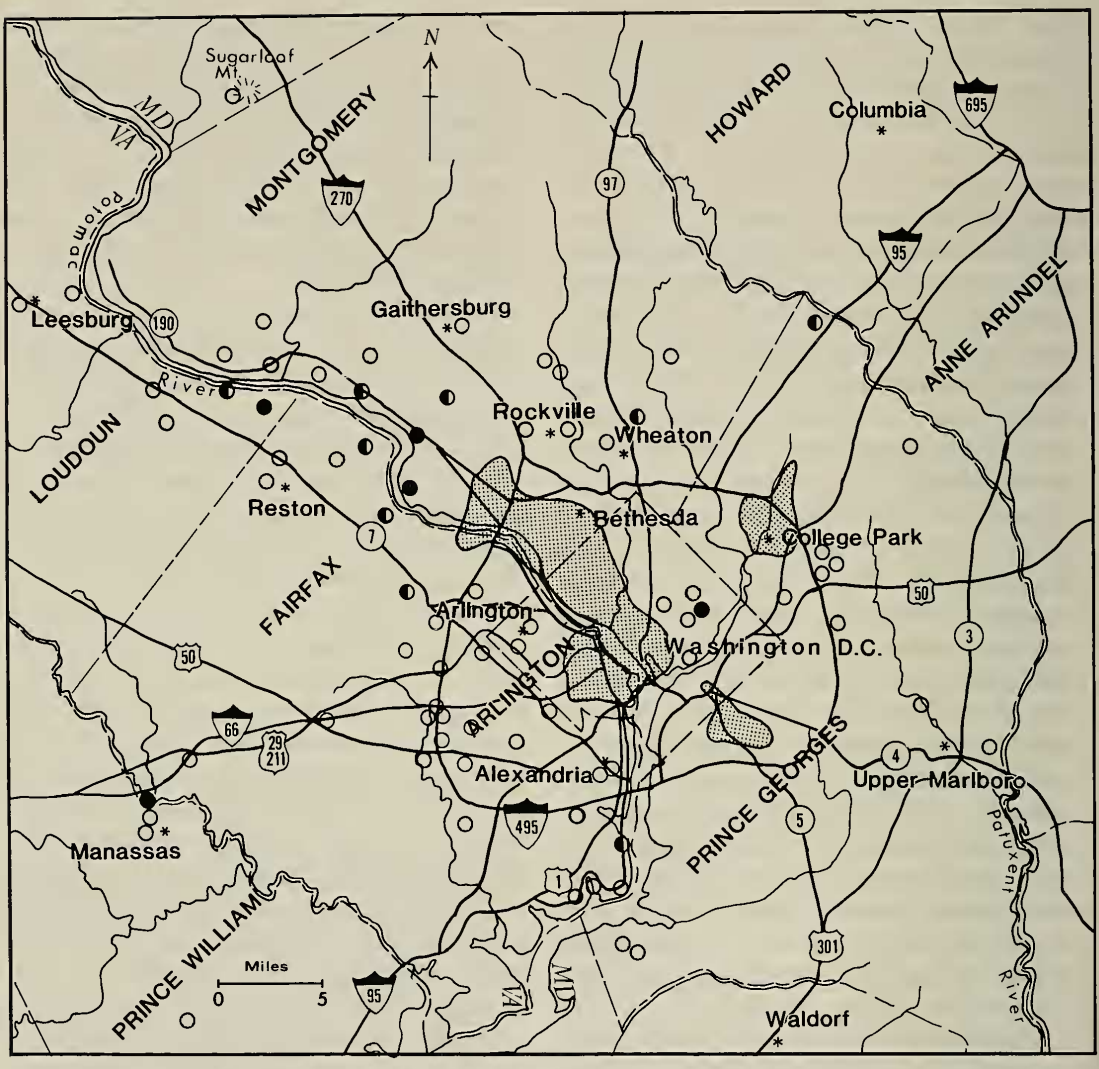

Fig. 1. Map of recording localities of spring-flowering plants, 1970–1983. The number of records from each locality is indicated by the following symbols: Open circle = 1–10 records, Half circle = 10–50 records, Solid circle = 50 or more records. Stippled areas are locations of heavy observation, with cited localities too dense to map.

in the cases where more than one variety was recorded for the same species.

For the native and naturalized species, the taxonomic circumscriptions and nomenclature largely follow the eighth edition of *Gray's Manual of Botany* (Fernald 1970). In some cases, the more recent interpretations of the *National List of Scientific Plant Names* (United States Soil Conservation Service 1982) were adopted. No infraspecific names were retained for native or naturalized species.

To determine whether a species was native or naturalized in the study area, we consulted Hermann's (1946) *Checklist of Plants in the Washington-Baltimore Area* and the separate Washington-Baltimore Herbarium in the U.S. National Herbarium (US) at the Smithsonian Institution. Any records for species not previously reported

from the wild in the study area were dropped from the database because of their doubtful status.

Throughout the life of the project, Shetler has served as the final authority for identifications of native and naturalized species when there has been any doubt. He personally identified many specimens brought in by observers who were unable to name them and corrected or verified many other doubtful determinations made by unsure observers. In the vast majority of cases, however, the observer made his or her own identification, which was accepted by Shetler, as recorded, unless there was good reason for questioning the identification. Nonetheless, Shetler accepts ultimate responsibility for the identifications, taxonomic interpretations, and nomenclature in this paper.

Computer analysis and graphing were done using a Honeywell 6680 mainframe, Calcomp 1051 Drum Plotter, and a custom built CPM microcomputer using DBASE II software.

Results

The records include observations on plants from 95 different plant families, although 40% of the records are for species of the following eight families: Asteraceae, Brassicaceae, Ericaceae, Fabaceae, Liliaceae, Ranunculaceae, Rosaceae, and Violaceae.

Figure 2 is a bar graph of the first-flowering dates of all the individual species for which there are four or more years of records. The species are arranged chronologically in order of their average first-flowering dates. The computer-generated bar for each species plots the first-flowering dates of the species on a calendar scale. Dates for other than the initial flowering stage are plotted with special symbols, as defined in the legend.

Cumulative numbers of species coming into flower by a given date are graphed according to certain categories (e.g., woody plants) in Figs. 3 and 4. These graphs were generated by plotting the species totals in one-week intervals. Each point on a particular graph represents the sum of all species of the given category that came into flower over the whole 14-year period during the given week. A weekly rather than a daily interval was chosen so as to balance out year-to-year variability produced by the obvious weekend peaks in date recording.

The top curve of each figure cumulates all species, regardless of category, by the weekly intervals of first-flowering. The other curves represent different categories of species. For this purpose, the species were classified in terms of life-form (Fig. 3: annual, biennial, perennial, or woody) and nativeness (Fig. 4). This information was gathered primarily from *Gray's Manual of Botany* (Fernald 1970) and the *Manual of Vascular Plants of Northeastern United States and Adjacent Canada* (Gleason and Cronquist 1963).

Discussion

The regular flowering season in the Washington area begins in late February or early March. Some plant species flower earlier in the year, however, especially when there are mild spells in the weather or when they occur in sheltered places. Figures 3 and 4 show 29 species coming into flower in early January over the 14-year period. Because the recording of flowering dates did not start until January 1st of each year, species that had begun to flower in the previous autumn and had remained in flower through the new year often were recorded as beginning to flower on or soon after January 1st. Consequently, the initial peak of first-flowering in January is an artifact of the method of data collection.

The species that appear to begin flowering in January and February are primarily widespread weedy introductions, such as common chickweed (*Stellaria media*), dandelion (*Taraxacum officinale*), henbit *La-*

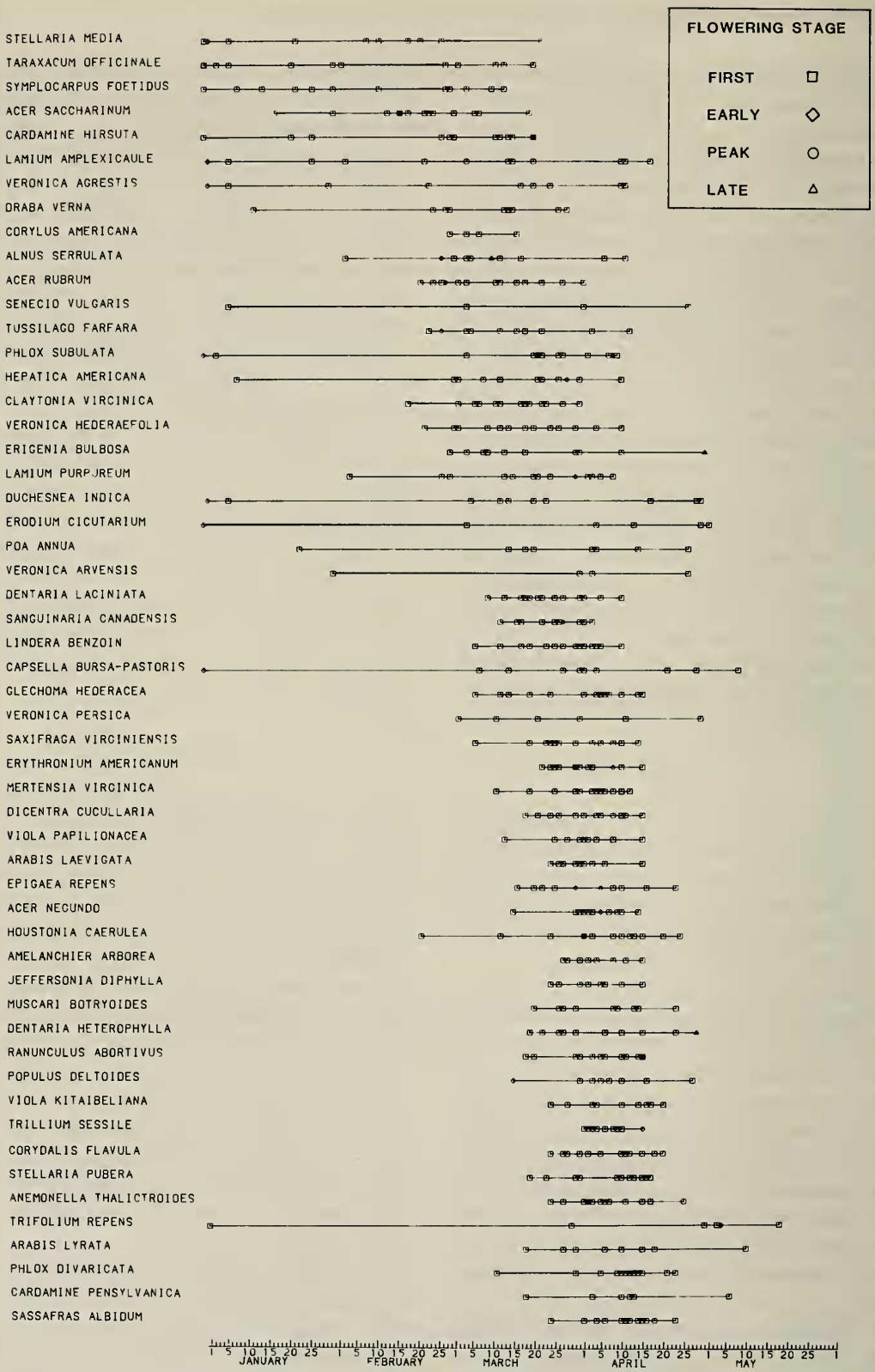

Fig. 2. List of recorded native or naturalized species with line graphs of actual dates of first-flowering. The species are listed in order of flowering, from earliest to latest, based on average first-flowering dates.


SENECIO AUREUS
DICENTRA CANADENSIS
CERCIS CANADENSIS
ACER SACCHARUM
POA CUSPIDATA
VIOLA ERIOCARPA
QUERCUS BOREALIS
RANUNCULUS SEPTENTRIONALIS
BARBAREA VULGARIS
ASARUM CANADENSE
ZIZIA AUREA
ERYTHRONIUM ALBIDUM
BRASSICA CAMPESTRIS
ALLIARIA OFFICINALIS
ANTENNARIA PLANTAGINIFOLIA
FRAGARIA VIRGINIANA
VIOLA AFFINIS
CARDAMINE BULBOSA
ARABIDOPSIS THALIANA
FLOERKEA PROSERPINACOIDES
VIOLA STRIATA
ORNITHOGALUM NUTANS
POTENTILLA CANADENSIS
CHAEROPHYLLUM PROCUMBENS
CAULOPHYLLUM THALICTROIDES
SILENE CAROLINIANA
ANEMONE QUINQUEFOLIA
UVULARIA SESSILIFOLIA
BETULA NIGRA
PANAX TRIFOLIUS
OBOLARIA VIRGINICA
RANUNCULUS BULBOSUS
AQUILEGIA CANADENSIS
VIOLA PEDATA
CORNUS FLORIDA
GERANIUM MACULATUM
LEPIDIUM VIRGINICUM
ARISAEMA TRIPHYLLUM
ANTENNARIA NEODIOICA
ANTHOXANTHUM ODORATUM
SCLERANTHUS ANNUUS
STAPHYLEA TRIFOLIA
VACCINIUM CORYMBOSUM
LIQUIDAMBAR STYRACIFLUA
OSMORHIZA CLAYTONI
VIBURNUM PRUNIFOLIUM
OSMORHIZA LONGISTYLIS
CERASTIUM ARVENSE
ASIMINA TRILOBA
VACCINIUM VACILLANS
SALIX NIGRA
MORUS ALBA
QUERCUS ALBA
QUERCUS PHELLOS
RUMEX ACETOSELLA
1 5 10 15 20 25 1 5 10 15 20 25 1 5 10 15 20 25 1 5 10 15 20 25 1 5 10 15 20 25 1
JANUARY
FEBRUARY
MARCH
APRIL
MAY


PODOPHYLLUM PELTATUM
PHACELIA RANUNCULACEA
POTENTILLA SIMPLEX
CYPRIPEDIUM ACAULE
POA PRATENSIS
GALIUM APARINE
DACTYLIS GLOMERATA
RHODODENDRON NUDIFLORUM
LEPIDIUM CAMPESTRE
ORNITHOGALUM UMBELLATUM
PAULOWNIA TOMENTOSA
KRIGIA DANDELION
UVULARIA PERFOLIATA
SEDUM TERNATUM
VICIA CAROLINIANA
ORCHIS SPECTABILIS
HYBANTHUS CONCOLOR
CHRYSOGONUM VIRGINIANUM
PLANTAGO LANCEOLATA
ERIGERON PHILADELPHICUS
PLANTAGO VIRGINICA
TRIFOLIUM PRATENSE
VIOLA PRIMULIFOLIA
PHACELIA DUBIA
CONOPHOLIS AMERICANA
PRUNUS SEROTINA
VACCINIUM STAMINEUM
RANUNCULUS RECURVATUS
VICIA ANGUSTIFOLIA
ROBINIA PSEUDO-ACACIA
PINUS VIRGINIANA
COMANDRA UMBELLATA
MAZUS JAPONICUS
OROBANCHE UNIFLORA
GERANIUM CAROLINIANUM
LIRIODENDRON TULIPIFERA
OXALIS STRICTA
TRIFOLIUM HYBRIDUM
HYDROPHYLLUM VIRGINIANUM
SMILACINA RACEMOSA
SOLANUM DULCAMARA
CHIONANTHUS VIRGINICUS
TRADESCANTIA VIRGINIANA
RUBUS FLAGELLARIS
SALVIA LYRATA
HYPOXIS HIRSUTA
LEUCOTHOE RACEMOSA
LONICERA JAPONICA
OXALIS VIOLACEA
HIERACIUM VENOSUM
SISYRINCHIUM SP
MELILOTUS OFFICINALIS
GAYLUSSACIA BACCATA
JUGLANS NIGRA
ILEX OPACA
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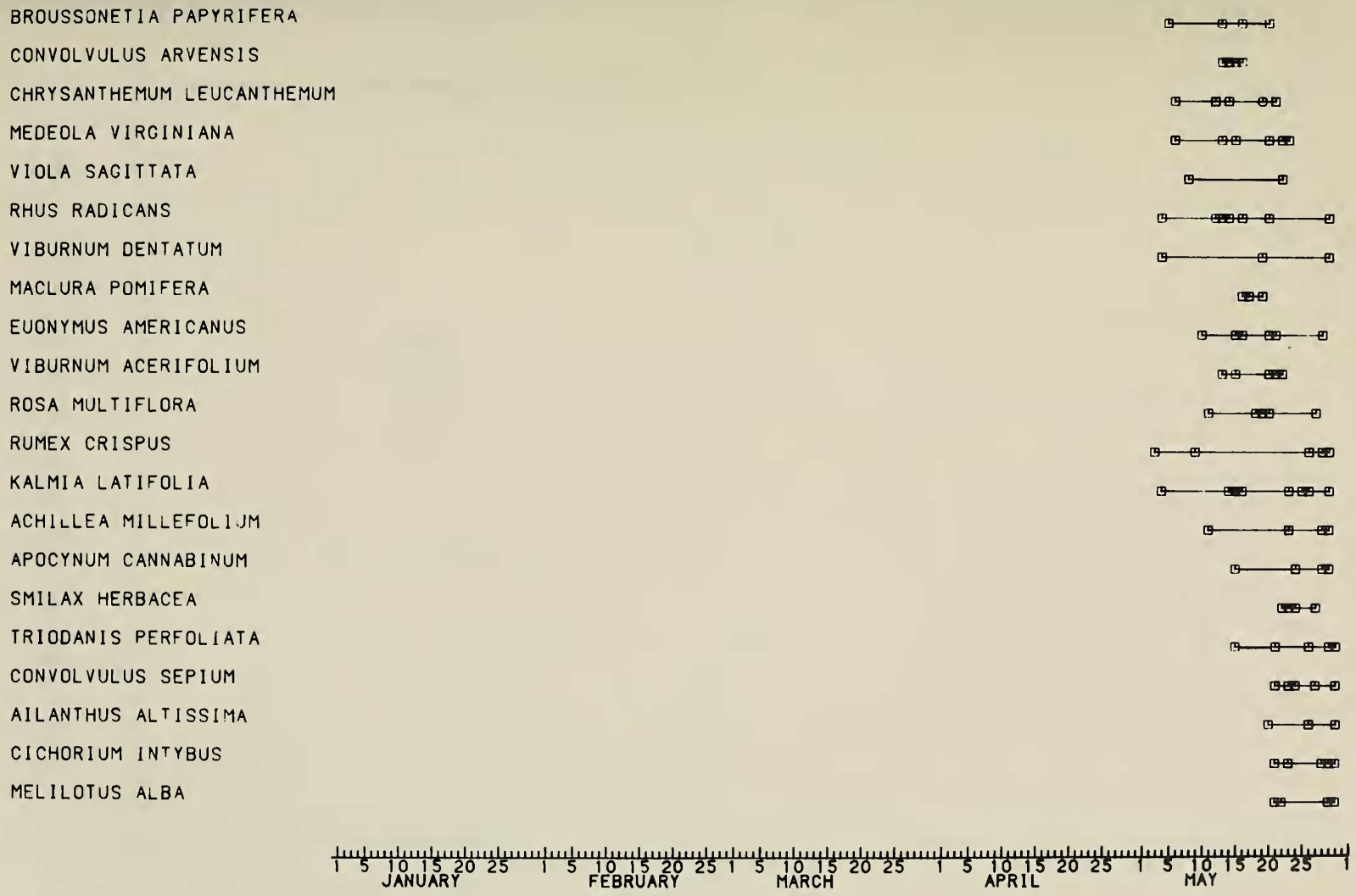
BROUSSONETIA PAPYRIFERA
CONVOLVULUS ARVENSIS
CHRYSANTHEMUM LEUCANTHEMUM
MEDEOLA VIRGINIANA
VIOLA SAGITTATA
RHUS RADICANS
VIBURNUM DENTATUM
MACLURA POMIFERA
EUONYMUS AMERICANUS
VIBURNUM ACERIFOLIUM
ROSA MULTIFLORA
RUMEX CRISPUS
KALMIA LATIFOLIA
ACHILLEA MILLEFOLIUM
APOCYNUM CANNABINUM
SMILAX HERBACEA
TRIODANIS PERFOLIATA
CONVOLVULUS SEPIUM
AILANTHUS ALTISSIMA
CICHORIUM INTYBUS
MELILOTUS ALBA
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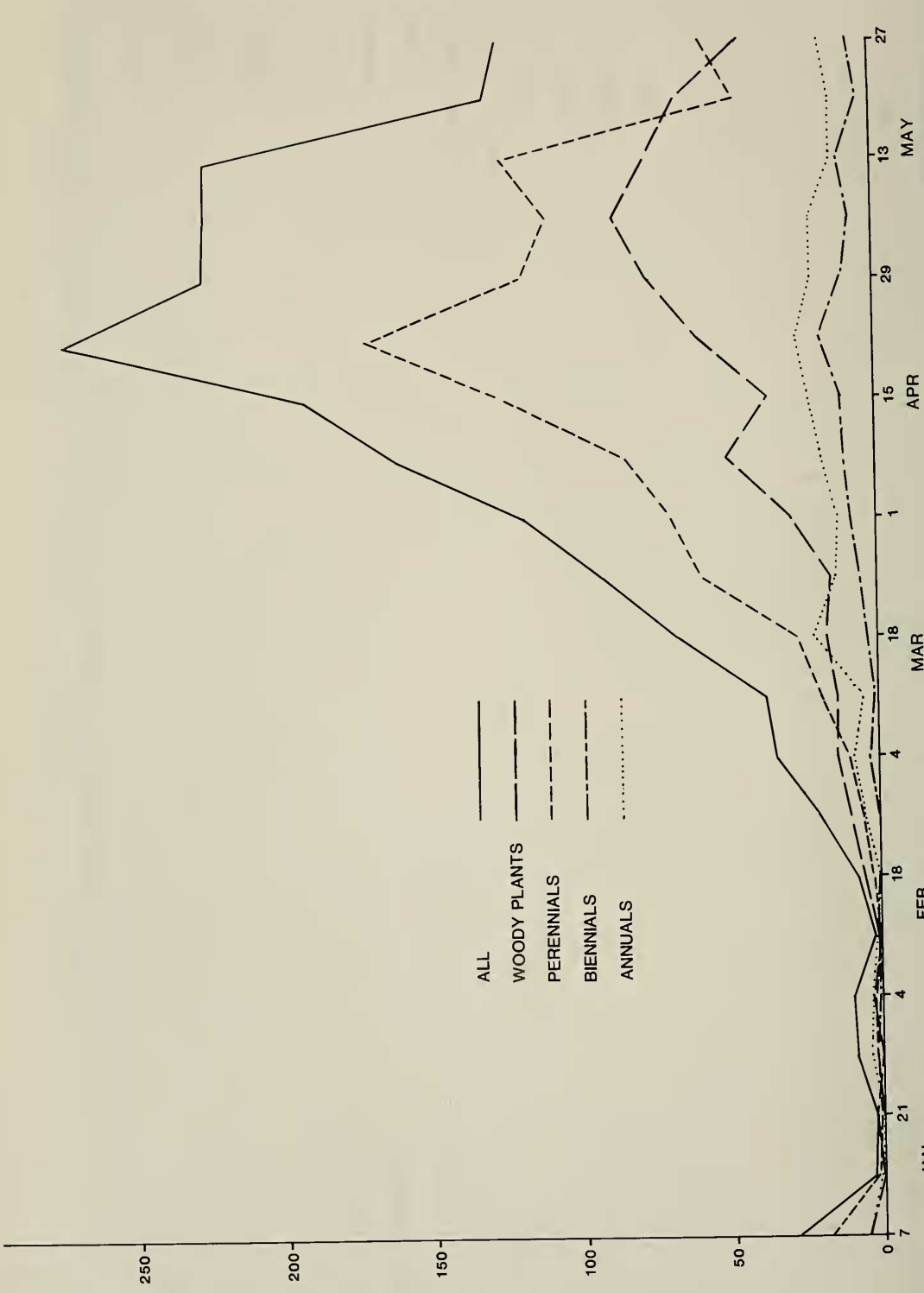

Fig. 3. Graphs of cumulative totals of species coming into flower week by week during the season. A total was generated by summing the number of species coming into flower over a prescribed one-week period in all 14 years studied. The top, solid line shows the total number of species coming into flower during a given one-week period. The other lines indicate the first-flowering progression for each of the different life-forms of plants

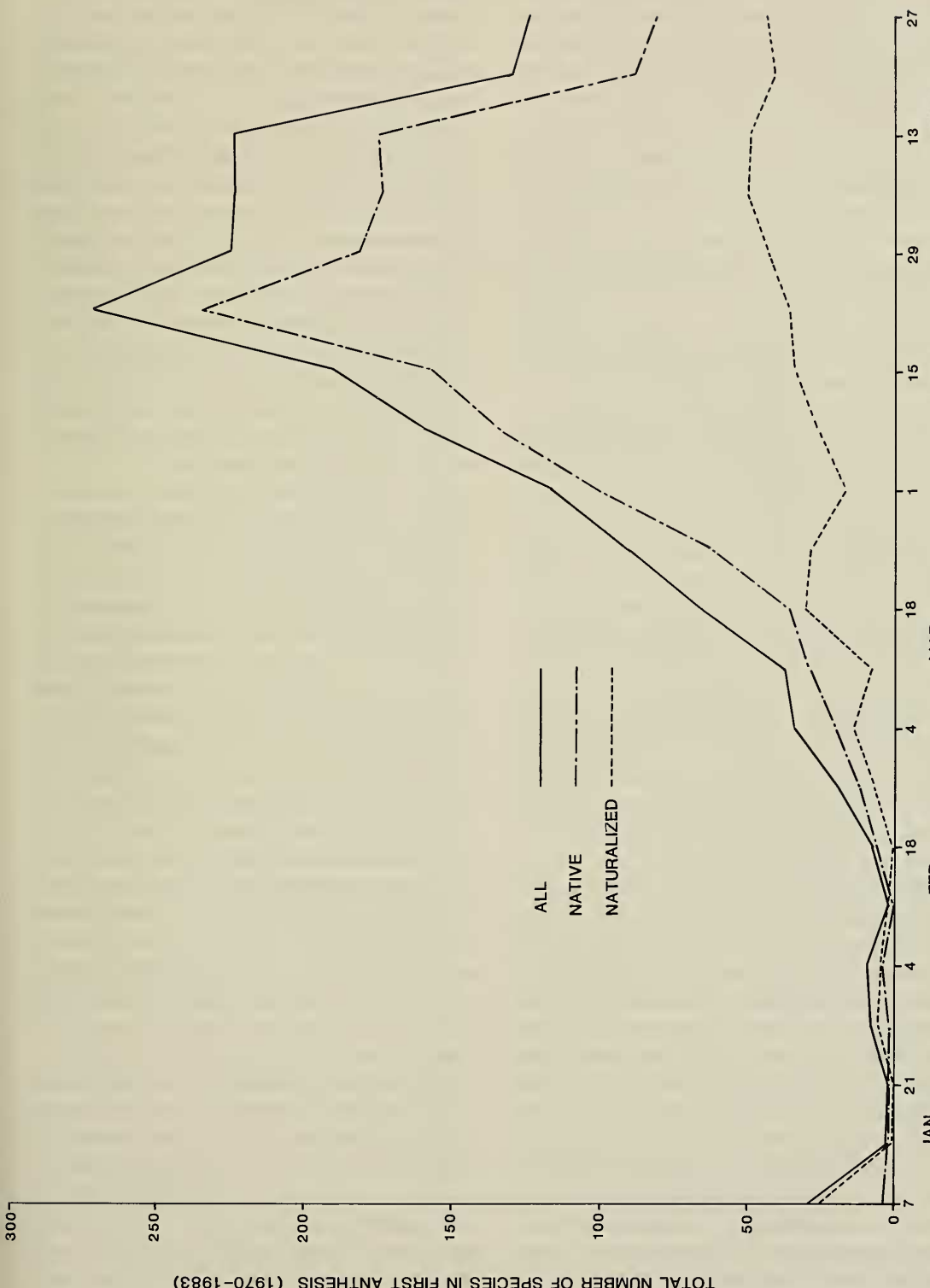

Fig. 4. Graphs of cumulative totals of species coming into flower week by week during the season, as in Fig. 3, but with the total broken down by "native" and "naturalized" instead of by life-forms.

mium amplexicaule), and speedwell (*Veronica agrestis*). Ward (1881) and Hitchcock and Standley (1919) noted that in our area several weedy species with inconspicuous flowers bloom quite early in the season or even during the winter months when the weather is warm or when they are growing in especially sunny or protected spots. Penfound (1956) observed that *Taraxacum officinale* flowers discontinuously throughout the year, even in December and January. It is obvious that some of our weedy species bloom in December as well as January. Variability in first-flowering dates of weedy species is discussed in more detail later.

Naturalized exotic species make up two-thirds of the species that start to flower between January 1st and mid-February. The number of naturalized exotic species coming into flower increases gradually through the course of the season. Looking at the season as a whole, exotic species account for approximately 25% of the plants observed.

Native species begin to bloom in late February. In mid- to late March, the number of native plants coming into bloom increases sharply. This rate continues to increase sharply until mid- to late April when the number of first-flowering plants reaches a peak. The level then drops at an equally sharp rate until late May when there is a slight resurgence (Fig. 4).

Initially we thought that the drop in first-flowerings in late May was caused by a lack of sustained interest on the part of our observers in recording first-flowering dates after the initial excitement of looking for spring wildflowers in bloom. However, other researchers have noted a similar peak and fall in the number of species coming into bloom. Anderson and Hubricht (1940) observed a drop in the number of species coming into bloom after the April peak. They attributed this peak to woodland plants whose blooms must be completed by the time the leaves of the canopy trees are fully expanded, when the available light that reaches the forest floor is greatly reduced. This same reasoning was used by Wolfe et al. (1949), Jackson (1966), Taylor (1974), and Heinrich (1976) to explain similar spring peaks in their data. Anderson and Hubricht (1940) noted that treeless habitats are not under the same pressure and do not experience a spring peak. Rather, the number of plants beginning to bloom rises slowly to reach a peak in midsummer. It is likely that the slight increase in the number of plants coming into flower that we observed in late May can be attributed to herbaceous species of open habitats, such as field bindweed (*Convolvulus arvensis*), ox-eye daisy (*Chrysanthemum leucanthemum*), yarrow (*Achillea millefolium*), chicory (*Cichorium intybus*), and yellow sweet clover (*Melilotus officinalis*), and to late-blooming woody species.

To analyze the controlling factors in flowering peaks, the species observed were divided into categories by life-form. This showed that woody plants accounted for 31% of the records. Sporadic blooming of woody plants has been recorded prior to mid-February. This was observed in silver maple (*Acer saccharinum*), common alder (*Alnus serrulata*), and American elm (*Ulmus americana*). The early blooming of *Acer* and *Ulmus* in our area was also noted by Hitchcock and Standley (1919). Generally, however, the woody plants in the D.C. region start their blooming period in late February. Flowering remains at a low level until late March, when the number of species coming into flower begins to climb. The number continues to climb steadily until it reaches a peak in late April. It then falls slightly and remains at a constant level through June 1st (Fig. 3).

The peak in blooming of woody plants can be partially explained by the fact that many of the woody plants studied are wind-pollinated. It is most advantageous for wind-pollination to occur before trees leaf out completely and their leaves impede air movement. This rationale has been proposed by Heinrich (1976) and Whitehead (1969). Our data tend to support this prop-

osition. Most of the wind-pollinated woody species, e.g., oaks (*Quercus* spp.), hazelnuts (*Corylus* spp.), river birch (*Betula nigra*), common alder (*Alnus serrulata*), American beech (*Fagus grandifolia*), American elm (*Ulmus americana*), and white ash (*Fraxinus americana*) begin to bloom before April 20 on the average. However, some wind-pollinated trees were observed to begin blooming after May 1st on the average. These are paper-mulberry (*Broussonetia papyrifera*), hickories (*Carya* spp.), black walnut (*Juglans nigra*), and osage-orange (*Maclura pomifera*). Most of the woody species that were observed beginning to bloom after May 1st on the average are not wind-pollinated, e.g., multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), northern dewberry (*Rubus flagellaris*), mountain laurel (*Kalmia latifolia*), tulip poplar (*Liriodendron tulipifera*), maple-leaved viburnum (*Viburnum acerifolium*), and deerberry and blueberries (*Vaccinium* spp.). Pollination information was obtained from Proctor and Yeo (1972) and Cronquist (1981).

The majority (53%) of the records are of perennial species. The perennial group, like the woody-plant group, begins blooming in late February. The rate of increase of species coming into flower, however, is much faster than among the woody plants observed. The number of first-flowering perennials reaches a peak in mid- to late April. This is slightly earlier than that for woody plants. The number of perennials coming into flower drops dramatically after this peak until late May when it shows a resurgence (Fig. 3).

Many of the perennials studied are woodland spring ephemerals, e.g., jack-in-the-pulpit (*Arisaema triphyllum*), spring beauty (*Claytonia virginica*), harbinger-of-spring (*Erigenia bulbosa*), cut-leaved toothwort (*Dentaria laciniata*), toadshade (*Trillium sessile*). As mentioned previously, these plants must complete a large part of their life-cycle before the trees have finished leafing out, cutting off their light supply. Thus, the woodland spring ephemerals are highly adapted to take advantage of the narrow "window" of time in early spring when temperature, moisture, and light conditions allow renewed growth but before the canopy closes over and greatly reduces the available light on the forest floor. This adaptive peak most likely is what explains the sharp spring peak in the blooming of perennials.

Annuals and biennials make up a relatively small portion of spring-flowering species recorded. Approximately 5% of the species recorded over the entire study period were biennials, and 11% were annuals. Once the first annuals and biennials begin to bloom the total numbers of these species coming into flower each one-week period remain relatively constant throughout the spring season and have little influence on the cumulative peak, in late April, for all plants coming into flower in a given week (Fig. 3, solid line).

The peaks in the cumulative flowering curves for all species recorded are formed mainly by native perennials and woody plants (cf. Figs. 3 and 4). Biennials, annuals, and all naturalized plants in this study come into flower at a relatively uniform rate throughout the season. Their flowering levels do not have a large impact on the overall peaks of flowering for all species.

The range of year-to-year first-flowering dates varies considerably from species to species (Fig. 2). It is to be expected that species whose flowering is primarily governed by day-length will show the least year-to-year variability in first-flowering date while those species whose flowering is governed more by climatic conditions will show the most year-to-year variability. Leopold and Jones (1947), Jacques and Hilleary (1945), and Moss (1960) suggested that the earliest blooming species are likely to show the most annual variation in the start of flowering. Our data support these suggestions. Table 1 shows that the average departure from the average first-flowering date decreases progressively through the spring

Table 1.—Average number of days of departure from average dates of first-flowering, tabulated in weekly intervals.

Week of average first flowering date	Average of departures from average first flowering date*
Jan 29–Feb 5	26
Feb 6–Feb 12	22
Feb 13–Feb 19	**
Feb 20–Feb 26	11
Feb 27–Mar 5	27
Mar 6–Mar 12	14
Mar 13–Mar 19	14
Mar 20–Mar 26	18
Mar 27–Apr 2	10
Apr 3–Apr 9	7
Apr 10–Apr 16	8
Apr 17–Apr 23	7
Apr 24–Apr 30	6
May 1–May 7	6
May 8–May 14	6
May 15–May 21	5
May 21–May 27	4

* Examples from the week of March 13–March 19 are used here to illustrate how the average departure from average first-flowering date was computed. Five species, *Veronica hederaefolia, Claytonia virginica, Hepatica americana, Phlox subulata,* and *Tussilago farfara,* have average first-flowering dates in this week. The absolute value of the departure of each first-flowering date (in days) from each species' own average first-flowering date was calculated for each year for which a first-flowering date was recorded. For example, *Claytonia virginica* has an average first-flowering date of March 15. In 1982 its first-flowering date was March 24, which was 9 days later than the average. In 1971 its first-flowering date was March 13, which was 2 days earlier than the average. The absolute values of the departure from the average for these two years were 9 and 2 days, respectively. All of the absolute differences for all five species were totalled and then averaged together to come up with the overall average absolute departure for this one-week period.

** None of the species analyzed has an average flowering date in this time period.

season. The blooming times of early-flowering species may be more directly related to climate than the blooming times of late-flowering species and, therefore, may be reflecting the greater variation in the climate early in the season by the greater variation in their first blooming dates.

Temperature as a controlling factor is suggested particularly by the year-to-year variation in the average day of first-flowering. When all first-flowering dates are expressed in number of days from January 1 and these dates are then averaged over all species that bloom after March 1 for each year, the average day of first-flowering is seen to vary from the 101st (1977) to the 115th day (1971, 1982) of the year. This is a maximum fluctuation of two weeks. This kind of variation certainly supports the common notion of "early" and "late" springs. On the other hand, the average day of first-flowering is exactly the same for as many as three years (1975, 1978, 1983). The observations were too uncontrolled to carry this analysis any further.

Of the species studied, those with the most pronounced variation in first-flowering dates (60+ days) tend to be the weedier species. Most of these are exotic annuals, e.g., henbit (*Lamium amplexicaule*), bird's-eye speedwell (*Veronica agrestis*), whitlow-grass (*Draba verna*), common groundsel (*Senecio vulgaris*), and shepherd's-purse (*Capsella bursa-pastoris*). A small number of exotic perennials, e.g., false strawberry (*Duchesnea indica*) and white clover (*Trifolium repens*), also show high variability. In the case of some plants the first-flowering period would look much less variable if one were to select the most discrete clump of five or so dates from among the total observations that may span a relatively wide period. These are species such as chickweed (*Stellaria media*) and poor-man's pepper (*Lepidium virginicum*) that begin their main flowering period in, say, April or May but often have scattered individuals or populations that begin flowering much earlier in sheltered locations or during a mild year. In reality the more discrete cluster of dates represents more accurately the typical range of first-flowering dates for the species. Sporadic early flowering, owing to habitat protection, mild weather, or genetic diversity among populations or individuals, is especially likely among weedy species whose success as weeds may be due in part to flowering times that are less synchronized than in other species. They certainly do not flower uniformly throughout the year, although they

may bloom sporadically in different seasons. Budd and Campbell (1959) suggest that in the range weeds that they studied early flowering may be an adaptation to enable the species to set seed before competitive grass species commence their rapid growth. Sporadic blooming aside, these species do have a time when a large proportion of their plants come into bloom. This probably would become apparent after many observations.

The native perennials that display long flowering spans, viz., blunt-leaved hepatica (*Hepatica americana*) and mosspink (*Phlox subulata*), may have one or two very early records, while the rest of the records are in a relatively discrete cluster. These early records may be aberrant, either recorded in a very warm year or recorded from a peculiar individual of a population in which the bulk of the population may have come into flower at a more predictable time.

Clearly, the onset of flowering in the spring is affected by a number of environmental variables. The earliest species vary the most in their flower initiation, but many species bloom year after year in a reasonably predictable time frame. This discrete pattern of flowering onset suggests, as many other studies have shown, a relatively precise adaptation to photoperiod and/or temperature regime (especially cumulative degree-days).

Some questions arise when attempting to interpret the flowering times of those species in our records with apparently discrete first-flowering spans. Although some species may truly flower in a quite discrete time span, there are at least two other possible explanations. On the one hand, in those cases where relatively few dates were recorded during the 14-year period there is less chance to vary, as, for example, in the cases of knawel (*Scleranthus annuus*), 5 records; narrow-leaved plantain (*Plantago lanceolata*), 5 records; and *Mazus japonicus,* 4 records. For such weedy species one would expect a more variable first-flowering span, which more records probably would show. Likewise, some of the species recorded toward the end of the final month (i.e., May) of the annual observation period may also appear to have discrete flowering periods when in fact a longer period (i.e., beyond June 1st) of recording might have shown that in some years first-flowering did not begin until after June 1st.

Given the rather uncontrolled way in which this study was conducted, one would not be justified in drawing more definite conclusions. Basically, we are presenting here a large set of observations that we think are of interest in themselves, and we have tried not to carry our analysis beyond what is justified by the nature of the data. Additional studies of individual species with a rigorous experimental design would be needed to answer the questions raised.

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Appendix 1.—Alphabetical list of spring-blooming native and naturalized species of plants of the Washington, D.C., area for which the date of first-flowering was recorded one or more times during the years 1970 to 1983.

Species	Range of dates	Average date	No. of years
Acer negundo	3/16–4/15	4/4	12
Acer rubrum	2/22–4/2	3/11	14
Acer saccharinum	1/18–3/20	2/22	14
Acer saccharum	4/4–4/20	4/12	5
Achillea millefolium	5/12–5/30	5/22	7
Acorus calamus	5/22–5/24	5/23	2
Actaea pachypoda	4/29–4/29	4/29	1
Ailanthus altissima	5/21–5/31	5/27	4
Ajuga reptans	4/1–5/9	4/16	8
Alliaria officinalis	3/31–4/29	4/15	13
Allium vineale	5/27–5/27	5/27	1
Alnus serrulata	2/4–4/12	3/10	10
Amelanchier arborea	3/28–4/16	4/5	8
Amelanchier canadensis	4/2–4/18	4/9	6
Amelanchier laevis	4/17–4/23	4/20	2
Anagallis arvensis	5/29–5/29	5/29	1
Anemone quinquefolia	4/10–4/25	4/20	8
Anemonella thalictroides	3/25–4/26	4/7	13
Antennaria neglecta	4/10–5/4	4/25	3
Antennaria neodioica	4/10–5/7	4/22	5
Antennaria parlinii	5/9–5/9	5/9	1
Antennaria plantaginifolia	3/31–5/1	4/16	6
Anthemis arvensis	4/29–5/26	5/13	3
Anthoxanthum odoratum	4/12–5/2	4/22	6
Aplectrum hyemale	5/14–5/22	5/17	4
Apocynum androsaemifolium	5/26–5/26	5/26	1
Apocynum cannabinum	5/16–5/30	5/25	4
Aquilegia canadensis	4/4–5/7	4/21	13
Arabidopsis thaliana	3/29–5/9	4/18	4
Arabis laevigata	3/25–4/16	4/3	10
Arabis lyrata	3/19–5/11	4/11	9
Arabis patens	4/20–5/11	4/29	3
Aralia nudicaulis	4/25–4/25	4/25	1
Arisaema dracontium	5/8–5/15	5/12	2
Arisaema triphyllum	4/14–4/29	4/22	13
Aronia arbutifolia	4/19–5/9	5/2	7
Aronia melanocarpa	4/24–5/10	5/1	3
Aronia prunifolia	5/4–5/12	5/8	2
Asarum canadense	3/28–4/25	4/14	13
Asimina triloba	4/12–5/3	4/25	11
Asparagus officinalis	5/11–5/16	5/14	2
Barbarea verna	4/7–4/7	4/7	1
Barbarea vulgaris	3/20–4/20	4/14	10
Betula nigra	4/7–4/29	4/20	3
Brassica campestris	4/7–4/25	4/15	4
Brassica nigra	5/24–5/24	5/24	1
Brassica rapa	4/16–4/16	4/16	1

Appendix 1.—Continued.

Species	Range of dates	Average date	No. of years
Broussonetia papyrifera	5/6–5/21	5/15	4
Caltha palustris	4/17–4/30	4/23	4
Capsella bursa-pastoris	1/1–5/9	3/28	10
Cardamine bulbosa	3/17–5/7	4/17	7
Cardamine hirsuta	1/1–3/21	2/27	14
Cardamine pensylvanica	3/19–5/7	4/11	6
Carex pensylvanica	4/11–4/16	4/14	2
Carex platyphylla	5/6–5/6	5/6	1
Carpinus caroliniana	3/27–4/29	4/10	6
Carya glabra	5/1–5/1	5/1	1
Carya tomentosa	5/2–5/7	5/5	2
Caulophyllum thalictroides	4/7–4/29	4/19	6
Ceanothus americanus	5/30–5/30	5/30	2
Celastrus orbiculatus	5/8–5/8	5/8	1
Celastrus scandens	5/5–5/11	5/8	2
Celtis occidentalis	4/29–4/29	4/29	1
Centaurea maculosa	5/24–5/24	5/24	1
Cerastium arvense	4/14–5/10	4/25	10
Cercis canadensis	3/23–5/2	4/12	12
Chaerophyllum procumbens	4/12–5/1	4/19	11
Chamaelirium luteum	5/12–5/12	5/12	1
Chelidonium majus	4/19–5/5	4/27	6
Chionanthus virginicus	4/29–5/19	5/10	12
Chrysanthemum leucanthemum	5/7–5/22	5/16	7
Chrysogonum virginianum	4/20–5/11	5/3	9
Cichorium intybus	5/22–5/31	5/27	6
Claytonia virginica	2/19–4/1	3/15	13
Clematis viorna	5/19–5/19	5/19	1
Comandra umbellata	4/29–5/23	5/7	4
Commelina communis	5/31–5/31	5/31	1
Comptonia peregrina	4/2–4/11	4/6	4
Conium maculatum	5/29–5/29	5/29	1
Conopholis americana	4/4–5/17	5/5	7
Convolvulus arvensis	5/14–5/17	5/16	4
Convolvulus sepium	5/22–5/31	5/26	5
Cornus florida	4/6–5/12	4/21	14
Coronilla varia	5/29–5/29	5/29	1
Corydalis flavula	3/25–4/21	4/8	14
Corylus americana	3/1–3/17	3/8	4
Corylus cornuta	2/23–3/19	3/7	2
Crepis japonica	5/9–5/9	5/9	1
Cryptotaenia canadensis	5/31–5/31	5/31	2
Cymbalaria muralis	4/3–4/29	4/16	2
Cynodon dactylon	5/31–5/31	5/31	1
Cynoglossum virginianum	5/14–5/14	5/14	1
Cypripedium acaule	4/17–5/10	4/28	6
Cypripedium calceolus	4/29–5/10	5/4	6

Appendix 1.—Continued.

Species	Range of dates	Average date	No. of years
Cytisus scoparius	4/28–5/8	5/2	3
Dactylis glomerata	4/19–5/4	4/29	4
Daucus carota	5/31–5/31	5/31	2
Dentaria heterophylla	3/20–4/24	4/5	11
Dentaria laciniata	3/10–4/11	3/25	14
Dicentra canadensis	4/1–4/29	4/12	10
Dicentra cucularia	3/19–4/16	4/3	14
Dioscorea quaternata	5/21–5/29	5/24	3
Dioscorea villosa	5/13–5/13	5/13	1
Diospyros virginiana	5/31–5/31	5/31	1
Dirca palustris	3/13–4/8	3/26	8
Dodecatheon meadia	4/17–4/25	4/22	3
Draba verna	1/13–3/29	3/8	11
Duchesnea indica	1/2–4/30	3/21	12
Epigaea repens	3/17–4/24	4/4	11
**Equisetum arvense*	4/19–4/19	4/19	2
Erigenia bulbosa	3/1–4/11	3/16	13
Erigeron annuus	5/15–5/15	5/15	1
Erigeron philadelphicus	5/5–5/11	5/8	3
Erigeron pulchellus	4/27–5/13	5/6	3
Erodium cicutarium	1/1–5/2	3/23	7
Erythronium albidum	4/7–4/19	4/15	9
Erythronium americanum	3/23–4/16	4/1	14
Euonymus americanus	5/11–5/29	5/19	7
Euphorbia commutata	4/20–4/20	4/20	1
Euphorbia cyparissias	4/19–5/7	4/30	3
Euphorbia supina	5/25–5/25	5/25	1
Fagus grandifolia	4/11–4/23	4/17	3
Festuca ovina	5/15–5/30	5/23	2
Floerkea proserpinacoides	4/9–4/25	4/18	9
Fragaria virginiana	4/4–5/9	4/17	10
Fraxinus americana	4/8–4/8	4/8	1
Galinsoga ciliata	5/20–5/22	5/21	2
Galium aparine	4/22–5/2	4/29	9
Gaylussacia baccata	4/30–5/26	5/13	4
Gaylussacia frondosa	5/12–5/20	5/16	2
Geranium carolinianum	4/5–5/28	5/8	6
Geranium maculatum	4/11–5/4	4/22	12
Geranium molle	5/15–5/15	5/15	1
Geum vernum	4/18–4/18	4/18	1
Gillenia trifoliata	5/23–5/23	5/23	1
Glechoma hederacea	3/7–4/16	3/31	13
Hepatica americana	1/9–4/11	3/16	13
Hesperis matronalis	4/25–5/8	4/30	4
Heuchera americana	5/15–5/21	5/17	3
Hieracium pratense	5/20–5/23	5/22	2
Hieracium venosum	5/5–5/23	5/13	4
Houstonia caerulea	2/22–4/25	4/4	14
Houstonia purpurea	5/23–5/23	5/23	1
Hybanthus concolor	5/5–5/11	5/7	3
Hydrophyllum virginianum	4/29–5/17	5/9	4

Appendix 1.—Continued.

Species	Range of dates	Average date	No. of years
Hypericum perforatum	5/30–5/30	5/30	1
Hypoxis hirsuta	4/28–5/23	5/11	5
Ilex opaca	5/8–5/22	5/14	9
Ilex verticillata	5/22–5/31	5/27	3
Impatiens capensis	5/28–5/28	5/28	1
Iris cristata	4/30–5/11	5/4	3
Iris verna	4/29–4/29	4/29	1
Iris versicolor	5/8–5/26	5/16	3
Isotria verticillata	4/29–5/16	5/5	3
Jeffersonia diphylla	3/25–4/16	4/6	10
Juglans nigra	5/4–5/20	5/13	4
**Juniperus virginiana*	3/13–3/28	3/23	3
Kalmia angustifolia	5/16–5/22	5/18	3
Kalmia latifolia	5/5–5/30	5/20	10
Krigia dandelion	4/29–5/5	5/1	4
Lamium amplexicaule	1/2–4/18	2/28	14
Lamium purpureum	2/5–4/9	3/19	13
Lathyrus venosus	5/9–5/9	5/9	1
Leonurus cardiaca	5/22–5/29	5/26	2
Lepidium campestre	4/3–5/11	4/30	5
Lepidium virginicum	1/2–5/23	4/22	6
Leucothoe racemosa	4/25–5/23	5/11	4
Linaria canadensis	5/22–5/30	5/25	3
Lindera benzoin	3/7–4/11	3/27	14
Linum usitatissimum	4/11–4/11	4/11	1
Linum virginianum	5/23–5/23	5/23	1
Liparis lilifiolia	5/21–5/29	5/25	2
Liquidambar styraciflua	4/19–4/30	4/24	5
Liriodendron tulipifera	4/21–5/21	5/8	14
Lithospermum arvense	4/25–4/25	4/25	1
Lobelia spicata	5/30–5/30	5/30	1
Lolium perenne	5/14–5/30	5/23	3
Lonicera japonica	4/17–5/30	5/11	9
Lonicera morrowii	4/20–5/6	4/28	2
Lonicera sempervirens	5/20–5/25	5/23	2
Lotus corniculatus	5/2–5/2	5/2	1
Lupinus perennis	5/7–5/7	5/7	1
Luzula campestris	3/24–4/16	4/8	3
Lyonia ligustrina	5/23–5/23	5/23	1
Lysimachia nummularia	5/20–5/24	5/22	3
Lysimachia quadrifolia	5/26–5/26	5/26	1
Lythrum salicaria	5/30–5/30	5/30	1
Maclura pomifera	5/17–5/20	5/19	5
Magnolia virginiana	5/3–5/22	5/13	5
Maianthemum canadense	4/19–5/7	4/30	5
Marrubium vulgare	5/29–5/29	5/29	2
Mazus japonicus	4/26–5/16	5/8	4
Medeola virginiana	5/7–5/24	5/16	7
Medicago lupulina	5/5–5/5	5/5	1
Medicago sativa	5/15–5/30	5/23	2
Melilotus alba	5/22–5/31	5/27	5
Melilotus officinalis	5/3–5/23	5/13	7
Mertensia virginica	3/12–4/13	4/2	14

Appendix 1.—Continued.

Species	Range of dates	Average date	No. of years
Mitchella repens	5/26–5/31	5/29	3
Mitella diphylla	4/17–5/2	4/23	5
Morus alba	4/19–5/5	4/26	5
Morus rubra	4/23–4/23	4/23	1
Muscari botryoides	3/21–4/24	4/6	9
Nepeta cataria	4/16–4/16	4/16	1
Nuphar advena	5/20–5/20	5/20	1
Nymphaea odorata	5/16–5/16	5/16	1
Nyssa sylvatica	5/3–5/27	5/15	8
Obolaria virginica	4/12–4/30	4/20	4
Oenothera laciniata	5/26–5/26	5/26	1
Oenothera tetragona	5/30–5/30	5/30	1
Opuntia humifusa	5/30–5/30	5/30	1
Orchis spectabilis	4/21–5/14	5/2	5
Ornithogalum nutans	4/10–4/25	4/18	5
Ornithogalum umbellatum	4/18–5/6	4/30	6
Orobanche uniflora	4/30–5/15	5/8	7
Orontium aquaticum	4/22–5/11	4/30	3
Osmorhiza claytoni	4/16–5/2	4/24	9
Osmorhiza longistylis	4/16–5/7	4/25	9
**Osmunda cinnamomea*	4/29–4/29	4/29	1
**Osmunda claytoniana*	4/29–4/29	4/29	1
Ostrya virginiana	3/27–4/29	4/15	3
Oxalis corniculata	4/12–4/12	4/12	1
Oxalis europaea	4/27–4/30	4/29	2
Oxalis grandis	5/5–5/5	5/5	1
Oxalis stricta	5/2–5/15	5/8	4
Oxalis violacea	4/30–5/23	5/11	5
Panax trifolius	4/1–5/7	4/20	9
Paulownia tomentosa	4/9–5/9	5/2	12
Phacelia dubia	4/29–5/13	5/5	4
Phacelia ranunculacea	4/18–4/29	4/25	6
Phleum pratense	5/31–5/31	5/31	1
Phlox divaricata	3/12–4/24	4/11	13
Phlox subulata	1/1–4/10	3/16	14
Physocarpus opulifolius	5/15–5/28	5/19	4
Phytolacca americana	5/31–5/31	5/31	1
**Pinus strobus*	5/15–5/28	5/19	4
**Pinus virginiana*	5/2–5/9	5/7	4
Plantago lanceolata	4/25–5/16	5/3	7
Plantago rugelii	5/26–5/26	5/26	1
Plantago virginica	4/25–5/10	5/3	4
Platanus occidentalis	4/25–5/3	4/30	5
Poa annua	1/24–4/27	3/23	9
Poa cuspidata	3/31–4/28	4/12	5
Poa pratensis	4/12–5/8	4/29	4
Podophyllum peltatum	4/14–5/5	4/27	14
Polygonatum biflorum	5/3–5/28	5/10	6
Polygonatum canaliculatum	5/16–5/16	5/16	1
Polygonum aviculare	4/15–4/15	4/15	1
Polygonum hydropiperoides	5/28–5/28	5/28	1

Appendix 1.—Continued.

Species	Range of dates	Average date	No. of years
Polygonum persicaria	5/24–5/24	5/24	1
Populus deltoides	3/16–4/28	4/8	8
Populus grandidentata	3/29–3/29	3/29	1
Potentilla argentea	5/17–5/17	5/17	1
Potentilla canadensis	4/8–4/29	4/18	10
Potentilla norvegica	5/24–5/30	5/27	2
Potentilla recta	5/9–5/26	5/18	2
Potentilla simplex	4/20–5/9	4/28	5
Prunus americana	3/16–4/21	4/3	2
Prunus angustifolia	3/9–4/25	3/27	3
Prunus pensylvanica	4/19–4/30	4/23	4
Prunus serotina	4/12–5/17	5/5	13
Prunus virginiana	5/11–5/11	5/11	1
Ptelea trifoliata	5/16–5/29	5/23	2
Quercus alba	4/23–4/30	4/26	4
Quercus borealis	3/29–4/24	4/13	5
Quercus coccinea	4/24–4/29	4/27	2
Quercus palustris	3/30–5/1	4/17	4
Quercus phellos	4/19–5/4	4/27	4
Quercus prinus	4/29–4/29	4/29	1
Quercus stellata	4/29–5/3	5/1	4
Ranunculus abortivus	3/19–4/16	4/7	14
Ranunculus acris	4/18–4/18	4/18	1
Ranunculus bulbosus	3/27–5/9	4/21	10
Ranunculus ficaria	3/25–3/25	3/25	1
Ranunculus hispidus	4/7–5/6	4/23	3
Ranunculus micranthus	4/12–4/24	4/18	2
Ranunculus recurvatus	4/28–5/11	5/6	7
Ranunculus septentrionalis	4/5–4/24	4/13	11
Rhododendron nudiflorum	4/19–5/13	4/30	11
Rhododendron viscosum	5/26–5/26	5/26	1
Rhus aromatica	4/11–4/19	4/16	4
Rhus radicans	5/5–5/30	5/16	7
Rhus typhina	5/26–5/29	5/28	2
Rhus vernix	5/20–5/20	5/20	1
Robinia pseudo-acacia	4/19–5/15	5/7	12
Rosa carolina	5/23–5/23	5/23	1
Rosa multiflora	5/12–5/28	5/20	5
Rubus allegheniensis	4/23–5/24	5/7	3
Rubus argutus	5/16–5/16	5/16	1
Rubus enslenii	5/11–5/11	5/11	1
Rubus flagellaris	5/5–5/12	5/9	5
Rumex acetosella	4/2–5/22	4/27	8
Rumex crispus	5/4–5/30	5/20	5
Sagina decumbens	3/28–5/1	4/10	3
Sagittaria rigida	5/30–5/30	5/30	1
Salix alba	4/2–5/5	4/19	2
Salix humilis	3/20–3/28	3/25	3
Salix nigra	3/21–5/9	4/26	4
Salix sericea	3/27–4/5	3/31	3
Salvia lyrata	4/28–5/28	5/11	7
Sambucus canadensis	5/20–5/25	5/23	4

Appendix 1.—Continued.

Species	Range of dates	Average date	No. of years
Sanguinaria canadensis	3/13–4/4	3/26	13
Sanicula gregaria	5/7–5/22	5/15	2
Sarracenia purpurea	5/9–5/12	5/10	3
Sassafras albidum	3/25–4/24	4/11	13
Saxifraga pensylvanica	4/29–4/29	4/29	1
Saxifraga virginiensis	3/7–4/15	3/31	13
Scleranthus annuus	4/16–5/4	4/23	5
Scutellaria serrata	5/4–5/22	5/13	2
Sedum ternatum	4/25–5/10	5/2	11
Senecio aureus	3/10–5/7	4/12	12
Senecio crawfordii	5/12–5/12	5/12	1
Senecio smallii	5/9–5/9	5/9	2
Senecio vulgaris	1/7–4/27	3/11	4
Silene alba	5/5–5/10	5/8	2
Silene caroliniana	3/31–5/4	4/19	10
Silene vulgaris (cucubalus)	5/9–5/9	5/9	1
Sisymbrium officinale	5/20–5/31	5/26	2
Sisyrinchium spp.	4/30–5/30	5/13	7
Smilacina racemosa	4/30–5/21	5/9	11
Smilacina stellata	5/9–5/9	5/9	1
Smilax herbacea	5/23–5/28	5/25	4
Smilax rotundifolia	5/23–5/23	5/23	1
Solanum carolinense	5/28–5/31	5/29	3
Solanum dulcamara	4/26–5/21	5/10	8
Solidago juncea	5/26–5/26	5/26	1
Sonchus asper	5/22–5/22	5/22	1
Sonchus oleraceus	5/16–5/20	5/18	2
Sparganium eurycarpum	5/23–5/29	5/27	4
Staphylea trifolia	4/11–4/30	4/22	9
Stellaria graminea	5/30–5/31	5/31	2
Stellaria longifolia	5/5–5/5	5/5	1
Stellaria media	1/1–3/23	1/28	13
Stellaria pubera	3/20–4/18	4/8	12
Symplocarpus foetidus	1/1–3/14	2/9	12
Taenidia integerrima	5/22–5/22	5/22	1
Taraxacum officinale	1/1–3/21	2/1	14
Thalictrum dioicum	4/17–5/7	4/27	2
Thalictrum polygamum	5/23–5/23	5/23	1
Thaspium barbinode	5/7–5/11	5/9	2
Thlaspi arvense	5/17–5/17	5/17	1
Tiarella cordifolia	4/16–4/29	4/22	4
Tilia americana	5/31–5/31	5/31	2
Tradescantia virginiana	4/28–5/26	5/10	5
Tragopogon pratensis	5/12–5/16	5/14	2
Trifolium dubium	5/8–5/20	5/15	3
Trifolium hybridum	4/29–5/21	5/9	4
Trifolium pratense	4/25–5/10	5/4	8
Trifolium procumbens	5/23–5/23	5/23	1
Trifolium repens	1/2–5/19	4/10	6
Trillium sessile	4/2–4/16	4/8	12

Appendix 1.—Continued.

Species	Range of dates	Average date	No. of years
Triodanis perfoliata	5/16–5/31	5/25	5
Triosteum angustifolium	5/9–5/9	5/9	1
**Tsuga canadensis*	4/24–4/30	4/26	3
Tussilago farfara	2/24–4/13	3/15	13
Typha angustifolia	5/29–5/29	5/29	1
Ulmus americana	2/1–3/22	3/2	14
Ulmus rubra	4/11–4/11	4/11	1
Urtica dioica	5/29–5/29	5/29	1
Uvularia perfoliata	4/21–5/10	5/2	8
Uvularia sessilifolia	4/8–5/1	4/19	9
Vaccinium angustifolium	4/22–4/24	4/23	2
Vaccinium atrococcum	4/7–5/9	4/26	3
Vaccinium corymbosum	4/10–5/13	4/23	6
Vaccinium stamineum	4/23–5/26	5/6	11
Vaccinium vacillans	4/20–5/9	4/26	7
Valeriana pauciflora	5/10–5/19	5/16	3
Veronica agrestis	1/2–4/12	2/28	9
Veronica arvensis	2/1–4/27	3/25	4
Veronica hederaefolia	2/23–4/11	3/18	14
Veronica officinalis	3/7–5/21	4/23	3
Veronica persica	3/3–4/30	3/31	7
Veronica serpyllifolia	5/15–5/15	5/15	1
Viburnum acerifolium	5/14–5/23	5/19	5
Viburnum dentatum	5/5–5/30	5/21	4
Viburnum prunifolium	4/11–5/4	4/25	12
Viburnum rafinesquianum	5/11–5/15	5/13	3
Viburnum recognitum	5/5–5/5	5/5	1
Vicia angustifolia	5/1–5/12	5/6	5
Vicia caroliniana	4/21–5/23	5/2	5
Vicia villosa	5/29–5/29	5/29	1
Viola affinis	4/1–4/27	4/17	5
Viola cucullata	4/4–4/13	4/10	3
Viola eriocarpa	3/18–5/2	4/12	13
Viola fimbriatula	4/12–5/9	4/24	3
Viola kitaibeliana	3/25–4/21	4/8	10
Viola papilionacea	3/14–4/16	4/3	14
Viola pedata	4/11–5/7	4/21	5
Viola primulifolia	4/21–5/9	5/4	4
Viola pubescens	4/12–4/16	4/14	2
Viola sagittata	5/9–5/23	5/16	4
Viola sororia	4/2–4/29	4/18	3
Viola striata	4/3–5/2	4/18	12
Viola triloba	4/29–5/10	5/3	3
Vitis labrusca	5/28–5/28	5/28	1
Vitis vulpina	5/23–5/25	5/24	2
Zizia aurea	3/25–5/19	4/15	9

* Non-flowering plants. Date of "first flowering" is date when spores are first released or when male cones begin to shed pollen.

Appendix 2.—Alphabetical list of spring-blooming cultivated species of plants of the Washington, D.C. area for which the date of first-flowering was recorded more than one time during the years 1970 to 1983.

Species	Range of dates	Average date	No. of years
Acer campestre	5/2–5/3	5/3	2
Acer palmatum	4/1–4/27	4/16	5
Acer platanoides	3/25–4/25	4/9	10
Acer pseudo-platanus	4/5–5/10	4/27	10
Actinidia arguta	5/10–5/24	5/19	4
Adonis amurensis	2/20–3/15	3/7	3
Aegopodium podagraria	5/21–5/26	5/24	2
Aesculus glabra	4/25–5/10	5/2	4
Aesculus hippocastanum	4/19–5/15	5/2	9
Aesculus pavia	4/25–5/4	4/30	5
Akebia quinata	4/11–4/17	4/14	4
Alchemilla vulgaris	4/19–4/24	4/22	3
Allium christophii	5/15–5/15	5/15	2
Allium fistulosum	5/2–5/16	5/8	3
Allium giganteum	5/21–5/29	5/25	2
Allium schoenoprasum	5/15–5/20	5/18	2
Amsonia tabernaemontana	4/25–5/4	4/30	4
Anemone "De Caen"	4/9–4/10	4/10	2
Anemone blanda	2/21–5/23	3/28	7
Anemone pulsatilla	3/15–4/2	3/21	3
Angelica archangelica	5/14–5/15	5/15	2
Antirrhinum majus	5/21–5/30	5/26	2
Aquilegia ecalcarata	5/1–5/7	5/4	2
Aquilegia flabellata	4/22–4/24	4/23	3
Arabis caucasica	1/26–4/2	3/1	3
Arctostaphylos uva-ursi	4/11–4/19	4/16	4
Arenaria grandiflora	5/15–5/15	5/15	2
Arenaria montana	5/6–5/15	5/9	3
Arisaema sikokianum	4/22–4/26	4/25	4
Arisaema thunbergii	4/30–5/2	5/1	2
Arisaema vingens	4/30–5/2	5/1	2
Aristolochia durior	5/15–5/16	5/16	2
Armeria juncea	4/17–4/26	4/22	2
Armeria juniperifolia	4/5–4/13	4/9	2
Armeria maritima	5/6–5/10	5/9	3
Armoracia rusticana	5/3–5/7	5/5	2
Arum italicum spp. *pictum*	5/15–5/26	5/21	2
Asarum minus	5/1–5/2	5/2	2
Asarum naniflora	4/19–5/2	4/26	2
Asarum shuttleworthii	4/19–5/9	4/30	4
Asarum virginicum	4/2–4/19	4/11	2
Aucuba japonica	3/11–4/18	4/1	5
Baptisia australis	5/2–5/10	5/6	3
Berberis gagnepainii	4/7–4/8	4/8	2
Berberis julianae	3/27–4/20	4/9	4
Berberis thunbergii	3/17–4/29	4/11	6
Betula pendula	4/4–4/10	4/7	2
Betula platyphylla	4/4–4/12	4/9	4
Betula populifolia	4/26–4/30	4/28	2
Bletilla striata	5/15–5/17	5/16	3
Borago officinalis	5/29–5/30	5/30	2
Brassica oleracea	3/17–4/10	3/29	2
Buxus semperiverens	3/6–4/13	3/26	6
Calendula officinalis	4/30–5/30	5/15	2
Calycanthus floridus	4/26–5/15	5/7	4
Camellia japonica	1/27–4/6	3/12	11
Campanula rotundifolia	5/9–5/30	5/16	3
Caragana arborescens	4/19–5/1	4/25	3
Carum carvi	4/25–5/29	5/7	4
Carya illinoensis	5/6–5/18	5/11	3
Catalpa speciosa	5/17–5/30	5/25	6
Centaurea montana	5/2–5/7	5/5	2
Centranthus ruber	5/2–5/15	5/8	3
**Cephalotaxus harringtonia*	4/16–4/17	4/17	2
Cercidiphyllum japonicum	3/24–4/6	3/31	4
Cercis chinensis	4/17–5/1	4/24	2
Chaenomeles japonica	1/15–4/16	3/3	5
Chaenomeles lagenaria	1/12–4/11	3/9	4
Chaenomeles speciosa	3/17–3/19	3/18	2
Chaenomeles sp.	1/1–3/29	2/12	4
**Chamaecyparis pisifera*	4/5–5/14	4/25	2
Cheiranthus cheiri	3/20–4/19	4/4	3
Chelidonium japonicum	4/13–4/26	4/21	3
Chimonanthus praecox	1/1–3/15	2/4	4
Chionanthus retusus	5/3–5/15	5/8	3
Chionodoxa luciliae	3/12–4/8	3/22	10
Chloranthus japonicus	4/5–4/17	4/14	4
Chrysanthemum coccineum	5/7–5/9	5/8	2
Chrysanthemum parthenium	5/29–5/29	5/29	2
Cladrastis lutea	5/5–5/10	5/8	2
Clematis addisonii	4/26–5/8	5/2	3
Clematis albicoma	4/26–5/2	4/28	3
Clematis coactilis	4/26–5/8	5/2	3
Clematis integrifolia	5/15–5/16	5/16	2
Clematis versicolor	5/16–5/27	5/22	2
Clematis viticaulis	5/13–5/22	5/17	3
Convallaria majalis	4/19–5/5	4/29	8
Coriandrum sativum	5/2–5/29	5/16	2
Coriaria japonica	5/23–5/26	5/25	2
Cornus kousa	5/16–5/27	5/22	5
Cornus mas	1/27–3/22	3/6	14
Corydalis ambigua	3/29–4/13	4/7	3
Corydalis lutea	4/2–4/18	4/12	3
Corydalis ochroleuca	4/17–4/20	4/19	2
Corylopsis pauciflora	3/14–4/5	3/25	5
Corylus avellana	1/2–4/4	3/2	8
Cotinus coggygria	5/22–5/23	5/23	2

Appendix 2.—Continued.

Appendix 2.—Continued.

Species	Range of dates	Average date	No. of years
Crataegus mollis	3/23–4/13	4/6	11
Crataegus phaenopyrum	5/27–5/29	5/28	2
Crocus biflorus var. *weldenii*	2/27–3/20	3/10	2
Crocus chrysanthus	1/28–2/11	2/4	2
Crocus etruscus	3/13–3/20	3/17	2
Crocus flavus	1/10–3/13	2/14	5
Crocus fleischeri	2/27–3/20	3/10	2
Crocus sieberi	1/10–3/20	2/16	5
Crocus tomasinianus	3/17–3/25	3/21	3
Crocus vernus	3/10–3/15	3/13	2
Crocus spp.	2/4–3/14	2/18	9
Croton alabamensis	4/2–4/17	4/10	2
**Cryptomeria japonica*	3/13–3/15	3/14	2
**Cunninghamia lanceolata*	4/19–4/26	4/23	2
Cyclamen coum	2/22–3/9	3/2	2
Daphne genkwa	3/27–4/14	4/7	3
Daphne odora	3/12–3/27	3/21	4
Daphne retusa	4/2–4/17	4/12	4
Datura stramonium	5/22–5/24	5/23	2
Delphinium tricorne	5/4–5/8	5/6	3
Dentaria multifida	4/13–4/22	4/18	2
Dianthus barbatus	5/2–5/7	5/5	2
Dianthus caryophyllus	4/24–5/20	5/7	2
Dicentra eximia	4/12–5/9	4/24	4
Dicentra formosa	4/17–4/24	4/21	2
Dicentra formosa var. *oregana*	4/20–4/24	4/22	2
Dicentra spectabilis	4/20–5/10	4/29	4
Dictamnus albus	5/7–5/9	5/8	3
Digitalis grandiflora	5/22–5/29	5/26	2
Digitalis purpurea	5/10–5/24	5/18	4
Draba rigida	3/20–3/29	3/25	2
Dracocephalum calophyllum	5/23–5/27	5/25	2
Endymion non-scriptus	4/27–5/4	5/1	2
Enkianthus campanulatus	5/6–5/28	5/17	2
Epimedium grandiflorum	4/2–4/17	4/11	5
Epimedium perralderanum	4/10–4/17	4/14	3
Epimedium sagittatum	4/10–5/2	4/21	2
Epimedium sempervirens	4/13–4/16	4/15	2
Epimedium × *rubrum*	4/5–4/14	4/10	3
Epimedium × *versicolor*	4/10–4/13	4/12	2
Epimedium × *warleyense*	4/2–4/14	4/9	4
Eranthis hyemalis	1/27–3/22	2/27	13
Erica carnea	2/2–4/21	3/19	6
Erythronium rostratum	3/27–3/29	3/28	2

Appendix 2.—Continued.

Species	Range of dates	Average date	No. of years
Eschscholzia californica	5/3–5/24	5/18	4
Eunomia oppositifolia	3/5–3/27	3/17	3
Euonymus alata	4/28–5/23	5/7	5
Euphorbia epithymoides	4/26–5/1	4/29	2
Forsythia suspensa	3/12–3/19	3/15	4
Forsythia spp.	1/1–3/22	2/25	8
Fothergilla gardenii	4/19–4/30	4/24	3
Fraxinus excelsior	4/8–4/16	4/12	3
Fritillaria imperialis	4/4–4/10	4/7	2
Fritillaria meleagris	4/5–4/22	4/15	3
Gaillardia pulchella	5/17–5/24	5/21	3
Galanthus elwesii	2/14–3/10	2/22	9
Galanthus nivalis	1/1–3/15	2/17	14
Galax urceolata	5/22–5/29	5/26	3
Galium odoratum	4/23–5/3	4/27	3
Genista sagittalis	5/16–5/27	5/22	2
Geranium macrorrhizum	5/7–5/16	5/10	3
Geranium phaeum	5/2–5/13	5/8	2
Geum rivale	3/13–3/27	3/20	2
Geum urbanum	5/15–5/20	5/18	2
**Ginkgo biloba*	4/19–5/2	4/25	4
Glaucium flavum	5/15–5/20	5/18	2
Gleditsia triacanthos	5/9–5/17	5/11	5
Globularia cordifolia	4/26–5/7	5/1	3
Gymnocladus dioica	5/18–5/31	5/24	3
Gypsophila repens	5/2–5/30	5/15	3
Halesia carolina	4/19–5/2	4/25	5
Hamamelis mollis	1/31–3/22	2/22	6
Hamamelis vernalis	2/1–2/27	2/14	2
Helianthemum nummularium	5/1–5/30	5/16	2
Heliotropium arborescens	5/20–5/29	5/25	2
Helleborus niger	3/5–3/17	3/9	4
Helleborus orientalis	2/14–3/20	3/5	5
Hemerocallis minor	5/20–5/22	5/21	2
Hepatica nobilis	3/5–3/20	3/14	5
Heuchera sanguinea	4/26–5/7	5/2	4
Hyacinthus orientalis	3/11–4/1	3/19	11
Hydrangea anomala	5/16–5/22	5/20	3
Hypericum fragile	5/15–5/27	5/21	2
Iberis sempervirens	1/1–4/5	3/6	7
Ilex aquifolium	4/14–4/26	4/20	2
Ilex crenata	5/24–5/29	5/26	3
Ilex glabra	5/30–5/31	5/31	3
Illicium floridanum	4/2–5/2	4/15	4
Ipheion uniflorum	3/29–4/17	4/7	3
Iris bakerana	3/1–3/17	3/9	3
Iris danfordiae	2/18–4/1	3/4	9
Iris gracilipes	5/2–5/16	5/8	3
Iris histrioides	3/1–3/9	3/5	2
Iris pseudacorus	5/8–5/30	5/17	3

Appendix 2.—Continued.

Species	Range of dates	Average date	No. of years
Iris reticulata	2/22–3/15	3/5	9
Iris × *germanica*	1/12–5/20	4/11	7
Isatis tinctoria	4/19–4/30	4/24	3
Itea virginica	5/29–5/31	5/30	4
Jasminum nudiflorum	1/1–3/22	2/10	14
Jeffersonia dubia	3/29–4/17	4/7	3
Kerria japonica	4/18–4/20	4/19	2
Kolkwitzia amabilis	5/3–5/20	5/11	3
Laburnum anagyroides	4/20–5/10	5/3	4
**Larix decidua*	4/4–4/20	4/12	2
Lavandula pinnata	5/28–5/29	5/29	2
Leitneria floridana	4/8–4/16	4/11	5
Leucojum aestivum	4/17–4/20	4/18	3
Leucothoe fontanesiana	4/24–5/2	4/29	3
Limnanthes alba	5/14–5/15	5/15	2
Linaria annua	4/10–5/1	4/21	2
Linum perenne	4/24–4/30	4/27	2
Lonicera fragrantissima	1/2–3/22	2/20	14
Lonicera maackii	5/7–5/8	5/8	2
Loropetalum chinense	4/11–5/15	4/25	3
Lychnis coronaria	5/22–5/30	5/26	2
Lyonia mariana	5/17–5/30	5/24	2
Magnolia acuminata	5/2–5/10	5/6	2
Magnolia ashei	5/15–5/27	5/23	3
Magnolia grandiflora	5/11–5/30	5/23	12
Magnolia kobus	3/19–4/5	3/28	2
Magnolia macrophylla	5/18–5/30	5/23	4
Magnolia stellata	3/4–3/28	3/17	14
Magnolia tripetala	5/1–5/11	5/6	4
Magnolia × *loebneri*	3/5–3/27	3/16	2
Magnolia × *soulangiana*	3/5–4/8	3/22	14
Mahonia aquifolium	3/20–4/5	3/29	5
Mahonia bealei	1/1–3/14	2/12	4
Mahonia repens	4/5–4/5	4/5	2
Mahonia spp.	1/25–2/28	2/11	2
Malus angustifolia	4/29–5/7	5/3	2
Malus baccata	4/12–4/17	4/15	2
Malus halliana	4/2–4/17	4/10	2
Malus hupehensis	3/23–4/11	4/3	9
Malus sylvestris	4/5–4/25	4/15	2
Matricaria recutita	5/2–5/7	5/5	2
Muscari armeniacum	3/20–4/13	4/1	2
Myrica cerifera	5/4–5/8	5/6	3
Myrica pensylvanica	4/25–5/7	5/1	4
Narcissus "February Gold"	3/3–3/25	3/15	5
Narcissus "Jack Snipe"	3/30–3/31	3/30	3
Narcissus "King Alfred"	3/17–3/18	3/18	2
Narcissus "Tete-a-tete"	3/13–3/20	3/16	3

Appendix 2.—Continued.

Species	Range of dates	Average date	No. of years
Narcissus asturiensis	3/5–3/20	3/13	2
Narcissus bulbocodium	4/10–4/17	4/14	2
Narcissus bulbocodium var. *conspicuus*	3/15–3/20	3/18	2
Narcissus jonquilla	4/23–5/8	5/1	2
Narcissus pseudo-narcissus	3/1–3/24	3/11	12
Narcissus scaberulus	3/18–4/13	3/31	2
Narcissus triandrus	3/6–4/17	3/27	2
Nigella damascena	5/22–5/29	5/25	3
Nothoscordum bivalve	4/22–5/1	4/26	4
Pachysandra procumbens	4/5–4/13	4/8	4
Pachysandra terminalis	3/7–4/21	3/28	10
Papaver orientale	5/10–5/20	5/15	2
Penstemon hirsutus	5/15–5/17	5/16	3
Penstemon pinifolius	5/15–5/27	5/21	2
Petasites japonicus	3/13–3/29	3/23	3
Philadelphus spp.	4/20–5/20	5/9	3
Phlox bifida	4/5–4/17	4/13	3
Phlox stolonifera	4/15–4/24	4/20	3
Phlox × *procumbens*	4/20–4/22	4/21	2
Picrasma quassioides	5/7–5/8	5/8	2
Pieris "Forest flame"	3/23–3/29	3/26	3
Pieris floribunda	3/12–3/27	3/20	2
Pieris japonica	2/22–3/23	3/12	14
**Pinus banksiana*	4/19–5/4	4/29	3
**Pinus densiflora*	5/7–5/8	5/8	2
**Pinus nigra*	4/24–5/5	5/1	5
**Pinus wallichiana*	5/22–5/31	5/26	4
Plantago psyllium	5/7–5/15	5/10	3
Platycladus orientalis	3/5–3/27	3/16	3
Polemonium reptans	4/8–5/2	4/20	2
Polygonatum falcatum	5/14–5/16	5/15	3
Polygonatum odoratum	5/1–5/2	5/2	2
Poncirus trifoliata	4/4–4/23	4/15	3
Populus tremuloides	3/20–4/5	3/28	4
Potentilla aurea	4/17–5/2	4/25	2
Potentilla fruticosa	5/2–5/7	5/5	2
Potentilla nevadensis	3/29–4/13	4/5	3
Potentilla tridentata	5/4–5/22	5/11	3
Primula japonica	5/2–5/16	5/10	4
Prunus "Flowering Cherry"	1/3–3/26	2/25	4
Prunus cerasifera	3/17–4/10	3/29	2
Prunus laurocerasus	1/1–4/30	4/7	7
Prunus mume	3/5–3/16	3/12	3
Prunus persica	3/24–3/25	3/25	2
Prunus subhirtella	3/12–4/10	3/26	4
Prunus yedoensis	3/4–4/6	3/26	9
Prunus yedoenesis/serrulata	3/17–4/9	3/29	5
Psoralea subacaulis	5/7–5/8	5/8	2

Appendix 2.—Continued.

Species	Range of dates	Average date	No. of years
Pterocarya stenoptera	4/11–4/23	4/15	3
Pulmonaria angustifolia	4/10–4/17	4/14	2
Pulmonaria officinalis	3/20–3/27	3/24	2
Puschkinia scilloides	3/4–4/1	3/19	9
Pyracantha "Mohave"	4/19–5/14	5/2	2
Pyracantha spp.	5/14–5/22	5/18	2
Pyrus calleryana	3/12–4/12	3/30	9
Pyrus communis	3/22–4/27	4/10	7
Quercus acutissima	4/21–4/23	4/22	2
Quercus falcata	4/14–4/24	4/20	6
Rhododendron "Azalea"	3/18–4/12	3/29	4
Rhododendron "Pioneer"	3/14–3/18	3/16	2
Rhododendron catawbiense	5/14–5/26	5/20	2
Rhododendron chapmanii	5/7–5/13	5/9	3
Rhododendron keiskei	3/29–4/10	4/4	2
Rhododendron mucronulatum	1/1–3/22	2/22	9
Rhodotypos scandens	4/26–5/29	5/18	3
Robinia hispida	5/15–5/29	5/22	2
Rorippa indica	5/20–5/22	5/21	2
Rosa foetida	5/8–5/14	5/10	3
Rosa rugosa	5/7–5/8	5/8	2
Rosmarinus officinalis	4/10–4/17	4/13	3
Ruta graveolens	5/9–5/29	5/18	3
Salix aegyptiaca	3/5–3/27	3/16	2
Salix babylonica	3/25–4/13	4/5	5
Salix caprea	3/8–4/5	3/23	4
Salix discolor	2/24–4/2	3/15	2
Salix glaucophylloides	4/2–4/4	4/3	2
Salix gracilistyla	3/15–3/23	3/19	3
Salix purpurea	3/20–3/27	3/24	2
Salix × *chrysocoma*	3/27–4/2	3/30	2
Salix spp.	2/27–3/4	3/2	2
Salvia officinalis	5/14–5/15	5/15	2
Sanguinaria canadensis (cv.)	3/29–4/14	4/6	2
Sanguisorba minor	5/3–5/8	5/6	3
Saponaria × *oliviana*	5/7–5/15	5/11	2
Sarcococca hookerana	3/5–4/12	3/22	4
Saxifraga caroliniana	5/7–5/15	5/11	2
Schivereckia doerfleri	3/27–4/13	4/5	2
Scilla bifolia	3/5–3/20	3/12	5
Scilla siberica	2/22–3/27	3/12	13
Scilla tubergeniana	3/12–3/29	3/21	4
Scorzonera hispanica	5/22–5/29	5/26	2
Sedum pulchellum	5/7–5/17	5/13	3
Senecio haworthii	4/17–4/26	4/22	3
Shortia galacifolia	3/12–4/14	3/29	5
Skimmia japonica	4/5–4/8	4/7	2
Spiraea prunifolia	3/30–5/2	4/20	3

Appendix 2.—Continued.

Species	Range of dates	Average date	No. of years
Spiraea × *vanhouttei*	4/24–5/13	5/6	6
Styrax japonicus	5/14–5/26	5/21	3
Styrax obassia	5/9–5/16	5/12	3
Symphytum officinale	4/25–5/7	5/1	3
Symplocos paniculata	4/25–5/7	5/2	4
Syringa oblata	4/11–4/23	4/17	2
Syringa vulgaris	3/30–4/24	4/14	9
**Taxodium distichum*	3/29–4/2	3/31	3
**Taxus baccata*	3/13–3/29	3/22	3
**Taxus cusipidata*	3/5–3/18	3/14	5
**Thuja occidentalis*	3/15–3/29	3/22	2
Thymus praecox	5/14–5/22	5/18	2
Thymus vulgaris	5/15–5/15	5/15	2
Tilia × *europaea*	5/27–5/31	5/29	3
Torreya nucifera	4/25–5/7	5/2	4
Tradescantia hirsuticaulis	5/2–5/8	5/5	3
Tradescantia longipes	5/1–5/7	5/4	2
Trillium cuneatum	4/1–4/22	4/10	4
Trillium decipiens	4/1–4/13	4/7	4
Trillium decumbens	4/5–4/13	4/9	4
Trillium discolor	5/7–5/8	5/8	2
Trillium erectum	4/14–5/7	4/23	6
Trillium grandiflorum	4/14–4/29	4/19	5
Trillium maculatum	4/5–4/13	4/9	3
Trillium ovatum	4/2–4/17	4/11	3
Trillium pusillum var. *pusillum*	3/31–4/1	3/31	3
Trillium pusillum var. *virginianum*	3/27–4/2	3/30	4
Trillium tschonoskii	3/29–4/13	4/7	3
Trillium underwoodii	4/9–4/24	4/17	3
Trillium viride	4/26–5/8	5/4	2
Trochodendron aralioides	5/3–5/17	5/10	2
Trollius europaeus	4/25–5/8	5/3	3
Tulbaghia violacea	5/8–5/16	5/12	2
Tulipa "Gold Coin"	3/21–4/2	3/27	2
Tulipa batalinii	4/19–4/26	4/23	2
Tulipa kaufmanniana	3/25–4/8	4/1	4
Tulipa kolpakowskiana	4/17–4/17	4/17	2
Tulipa linifolia	4/26–5/1	4/29	2
Tulipa maximowiczii	4/20–5/1	4/26	2
Tulipa pulchella var. *violacea*	3/18–3/27	3/23	2
Tulipa spp.	3/27–4/4	3/30	5
Valeriana officinalis	5/8–5/14	5/10	3
Vancouveria hexandra	5/17–5/22	5/20	2
Viburnum alnifolium	4/26–5/4	4/30	2
Viburnum carlesii	2/19–4/17	4/1	10
Viburnum farreri	2/12–4/8	3/17	3
Viburnum plicatum	5/7–5/8	5/8	2

Appendix 2.—Continued.

Species	Range of dates	Average date	No. of years
Viburnum rhytidophyllum	4/13–5/2	4/25	3
Vinca minor	1/1–4/7	3/13	14
Viola canadensis	4/17–4/30	4/25	3
Viola labradorica	4/10–4/15	4/13	2
Viola odorata	3/13–4/12	3/25	4
Viola tricolor	1/1–4/11	2/6	8
Waldsteinia lobata	4/17–4/17	4/17	2
Weigelia florida	5/13–5/14	5/14	2
Weigelia japonica	5/8–5/11	5/10	2

Appendix 2.—Continued.

Species	Range of dates	Average date	No. of years
Wisteria floribunda	4/16–4/27	4/21	3
Wisteria sinensis	3/30–5/6	4/20	5
Wisteria spp.	4/17–5/2	4/25	4
Xanthorhiza simpliciss-ima	4/11–4/12	4/12	2
Zelkova serrata	4/20–4/26	4/23	2

* Non-flowering plants. Date of "first flowering" is date when spores are first released or when male cones begin to shed pollen.